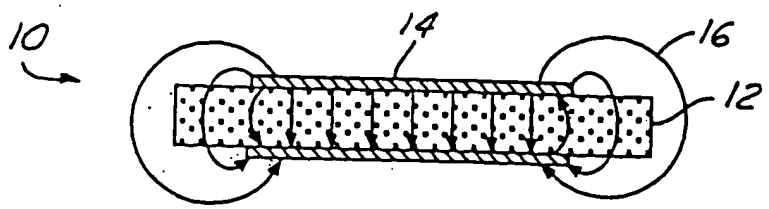
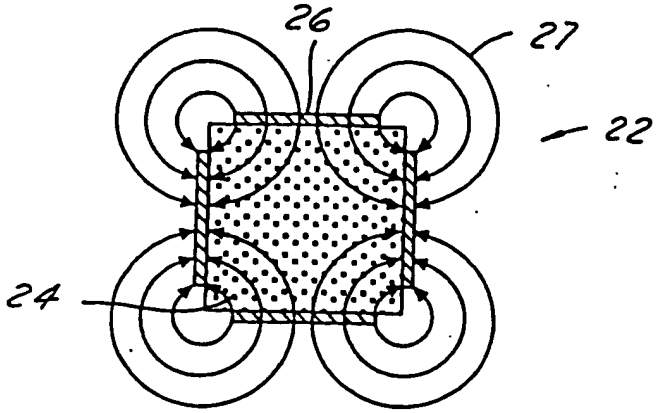
OIPE JC10
MAR 2 8 2005
PATENT & TRADEMARK OFFICE



CROSS-SECTION OF TSM RESONATOR PLATE

FIG. 1a



CROSS-SECTION OF TUNUNG FORK TINE

FIG. 1b

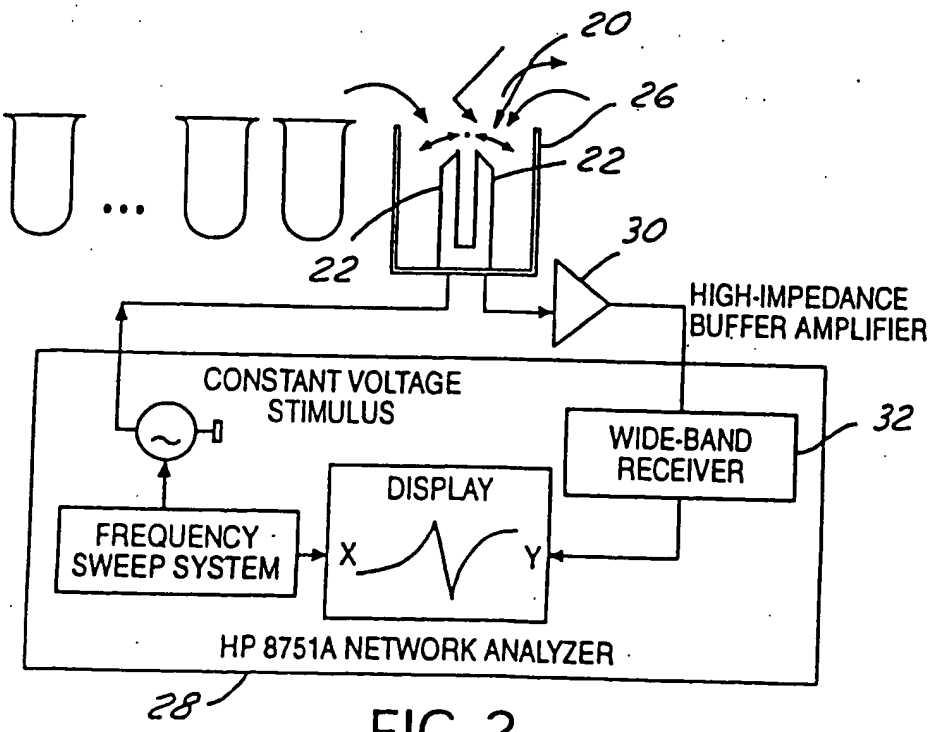


FIG. 2

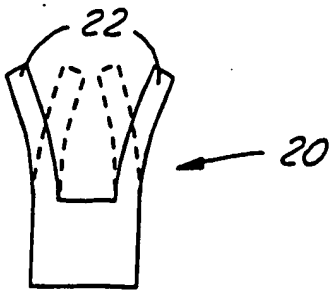


FIG. 3

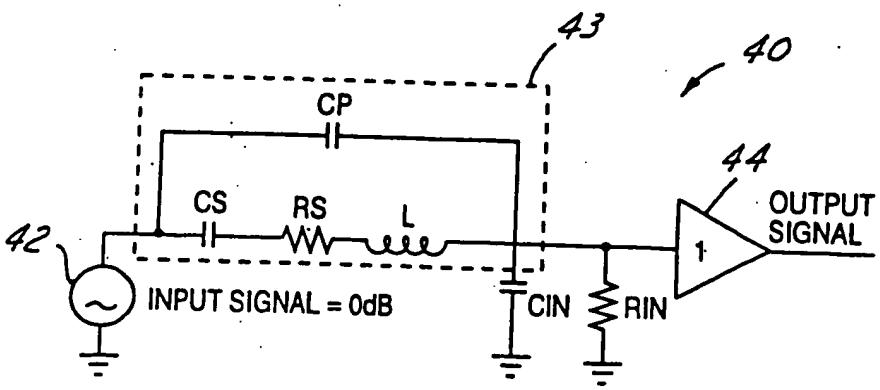


FIG. 4a

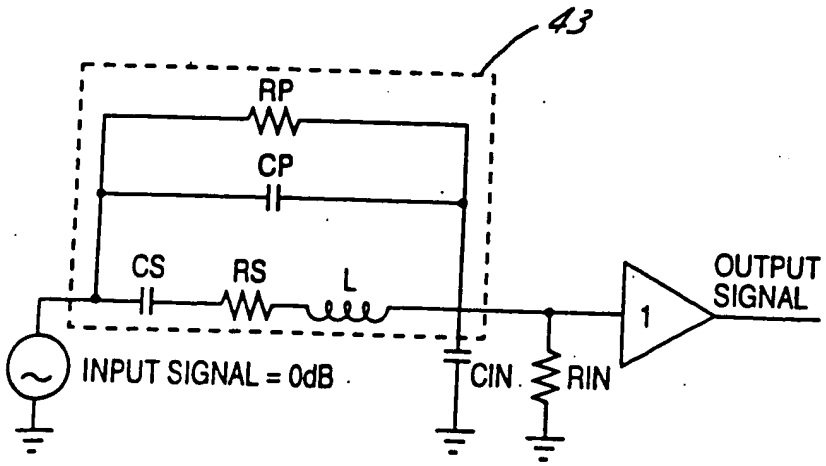


FIG. 4b

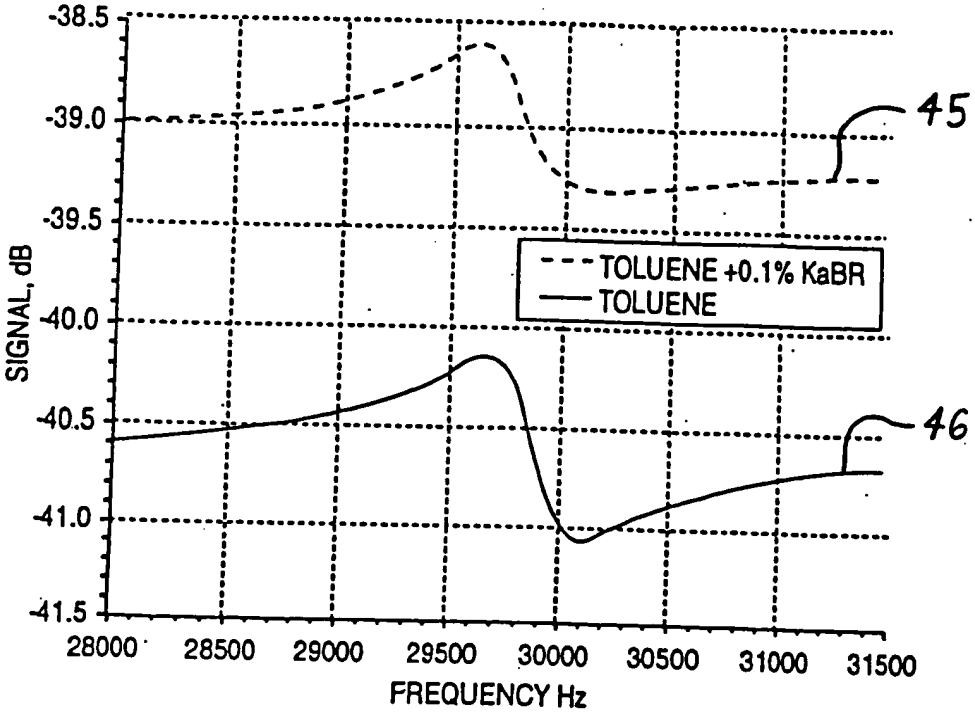

-38.5
-39.0
-39.5
-40.0
-40.5
-41.0
-41.5
SIGNAL, dB
28000
28500
29000
29500
30000
30500
31000
31500
FREQUENCY Hz
TOLUENE +0.1% KaBR
TOLUENE
45
46

FIG.4c

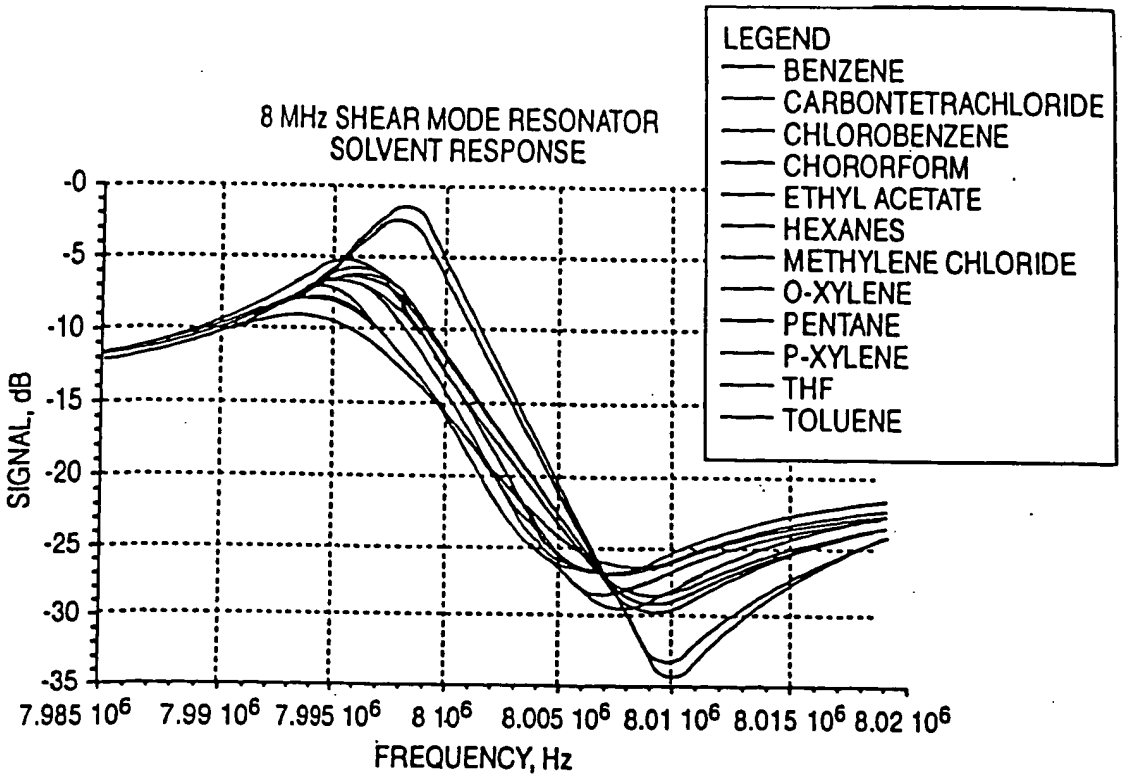

8 MHz SHEAR MODE RESONATOR
SOLVENT RESPONSE
LEGEND
BENZENE
CARBONTETRACHLORIDE
CHLOROBENZENE
CHORORFORM
ETHYL ACETATE
HEXANES
METHYLENE CHLORIDE
O-XYLENE
PENTANE
P-XYLENE
THF
TOLUENE
SIGNAL, dB
-0
-5
-10
-15
-20
-25
-30
-35
7.985 10^6
7.99 10^6
7.995 10^6
8 10^6
8.005 10^6
8.01 10^6
8.015 10^6
8.02 10^6
FREQUENCY, Hz

FIG.5a

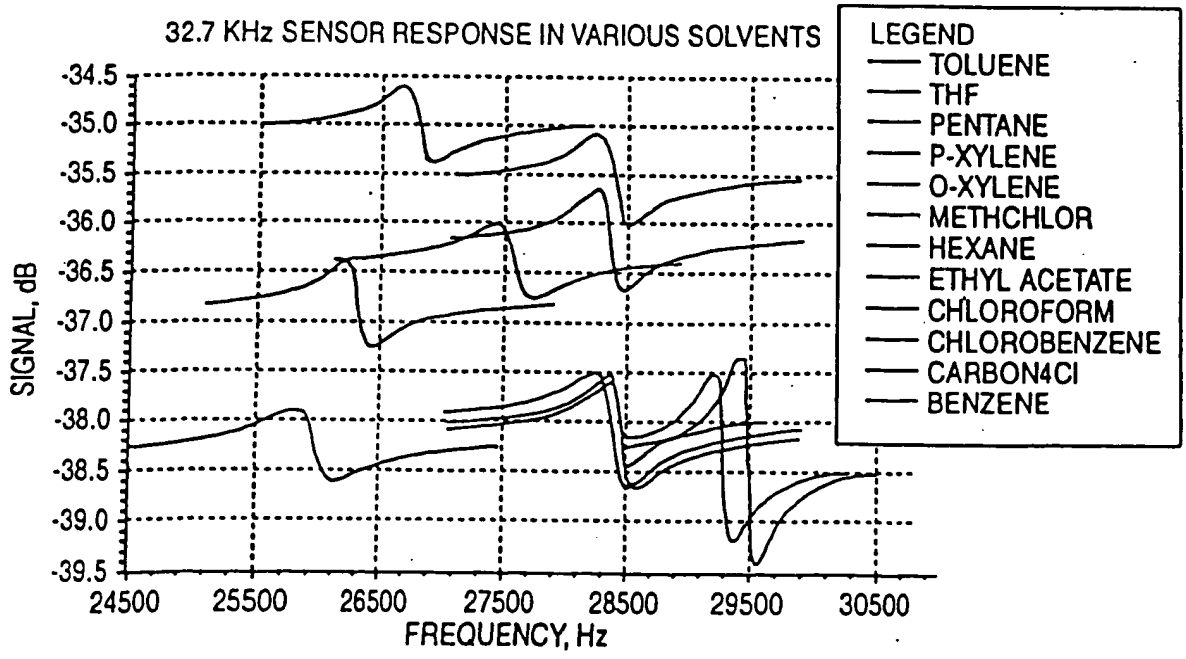

32.7 KHz SENSOR RESPONSE IN VARIOUS SOLVENTS
LEGEND
TOLUENE
THF
PENTANE
P-XYLENE
O-XYLENE
METHCHLOR
HEXANE
ETHYL ACETATE
CHLOROFORM
CHLOROBENZENE
CARBON4CI
BENZENE
SIGNAL, dB
-34.5
-35.0
-35.5
-36.0
-36.5
-37.0
-37.5
-38.0
-38.5
-39.0
-39.5
24500
25500
26500
27500
28500
29500
30500
FREQUENCY, Hz

FIG.5b

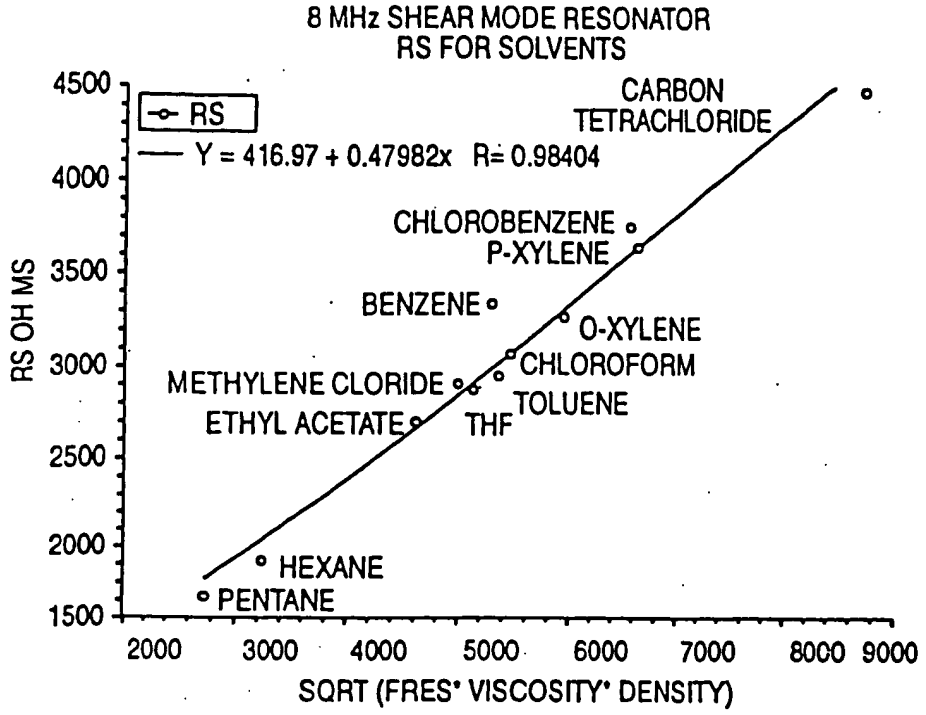

8 MHz SHEAR MODE RESONATOR
RS FOR SOLVENTS
RS
Y = 416.97 + 0.47982x R= 0.98404
RS OH MS
SQRT (FRES* VISCOSITY* DENSITY)
4500
4000
3500
3000
2500
2000
1500
2000
3000
4000
5000
6000
7000
8000
9000
CARBON TETRACHLORIDE
CHLOROBENZENE
P-XYLENE
BENZENE
O-XYLENE
CHLOROFORM
METHYLENE CLORIDE
TOLUENE
ETHYL ACETATE
THF
HEXANE
PENTANE

FIG.6a

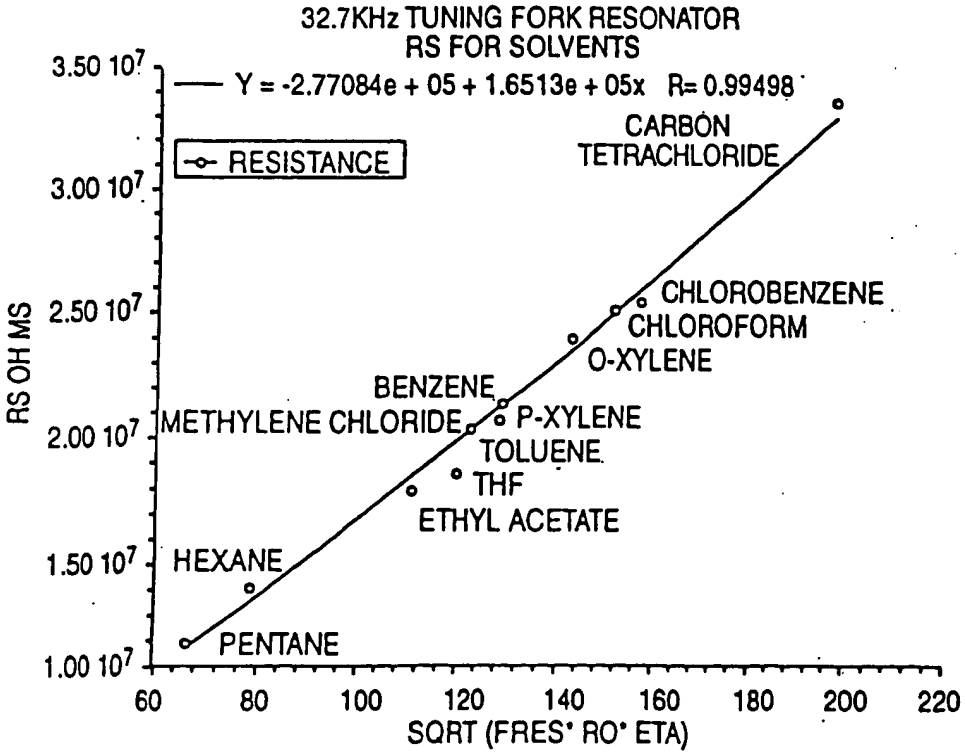

32.7KHz TUNING FORK RESONATOR
RS FOR SOLVENTS
Y = -2.77084e + 05 + 1.6513e + 05x R= 0.99498
RESISTANCE
RS OH MS
SQRT (FRES* RO* ETA)
3.50 10^7
3.00 10^7
2.50 10^7
2.00 10^7
1.50 10^7
1.00 10^7
60
80
100
120
140
160
180
200
220
CARBON TETRACHLORIDE
CHLOROBENZENE
CHLOROFORM
O-XYLENE
BENZENE
METHYLENE CHLORIDE
P-XYLENE
TOLUENE
THF
ETHYL ACETATE
HEXANE
PENTANE

FIG.6b

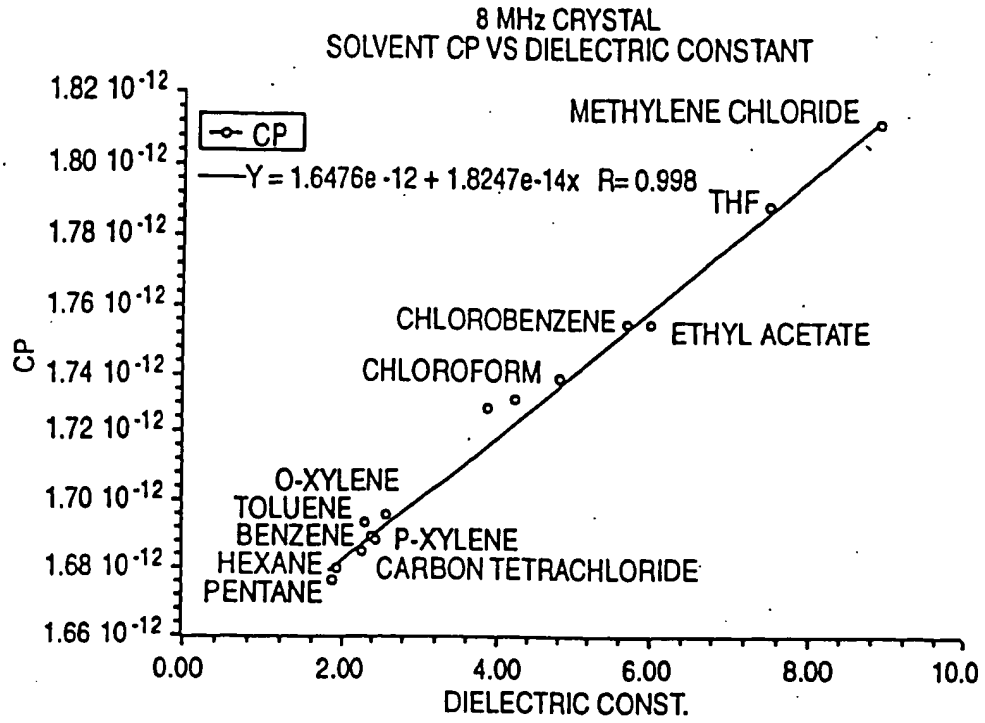

8 MHz CRYSTAL
SOLVENT CP VS DIELECTRIC CONSTANT
CP
Y = 1.6476e -12 + 1.8247e-14x R= 0.998
1.82 10-12
1.80 10-12
1.78 10-12
1.76 10-12
1.74 10-12
1.72 10-12
1.70 10-12
1.68 10-12
1.66 10-12
METHYLENE CHLORIDE
THF
CHLOROBENZENE
ETHYL ACETATE
CHLOROFORM
O-XYLENE
TOLUENE
BENZENE
P-XYLENE
HEXANE
CARBON TETRACHLORIDE
PENTANE
0.00
2.00
4.00
6.00
8.00
10.0
DIELECTRIC CONST.

FIG.7a

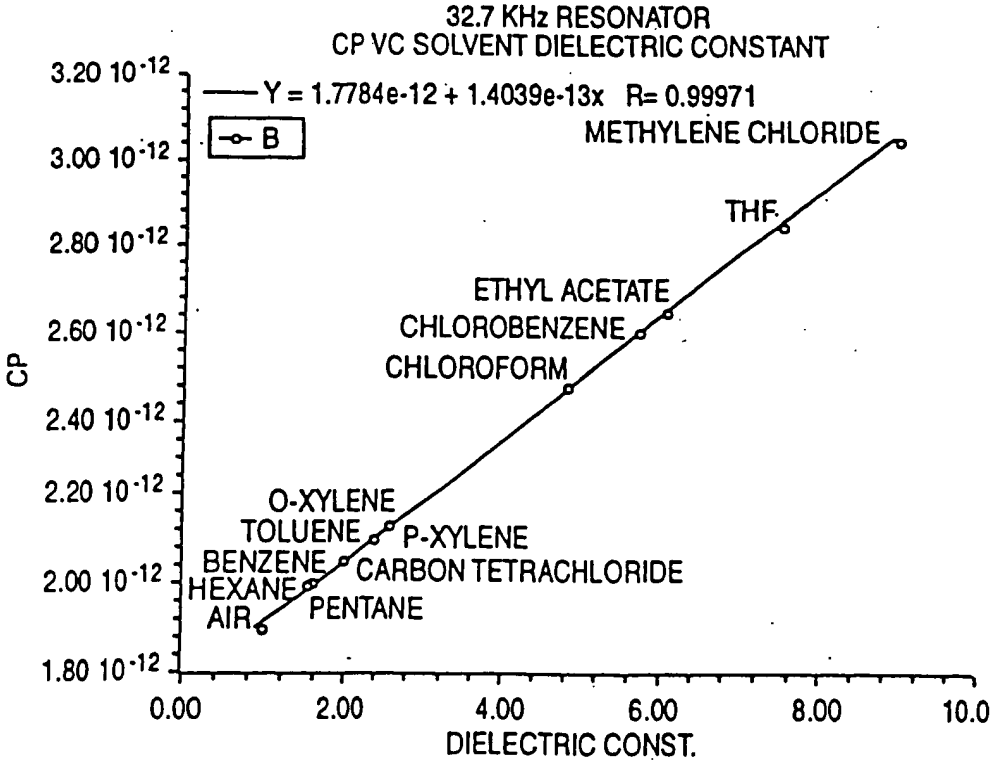

32.7 KHz RESONATOR
CP VC SOLVENT DIELECTRIC CONSTANT
CP
Y = 1.7784e-12 + 1.4039e-13x R= 0.99971
B
3.20 10-12
3.00 10-12
2.80 10-12
2.60 10-12
2.40 10-12
2.20 10-12
2.00 10-12
1.80 10-12
METHYLENE CHLORIDE
THF
ETHYL ACETATE
CHLOROBENZENE
CHLOROFORM
O-XYLENE
TOLUENE
P-XYLENE
BENZENE
CARBON TETRACHLORIDE
HEXANE
PENTANE
AIR
0.00
2.00
4.00
6.00
8.00
10.0
DIELECTRIC CONST.

FIG.7b

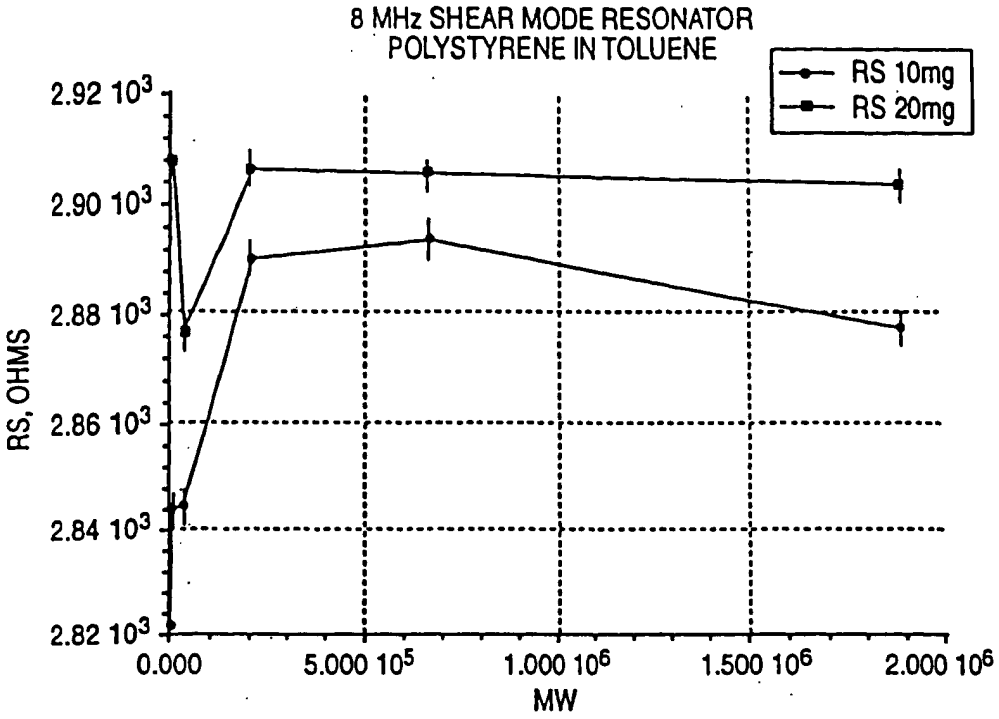

8 MHz SHEAR MODE RESONATOR
POLYSTYRENE IN TOLUENE
RS 10mg
RS 20mg
RS, OHMS
2.92 10³
2.90 10³
2.88 10³
2.86 10³
2.84 10³
2.82 10³
0.000
5.000 10⁵
1.000 10⁶
1.500 10⁶
2.000 10⁶
MW

FIG.8a

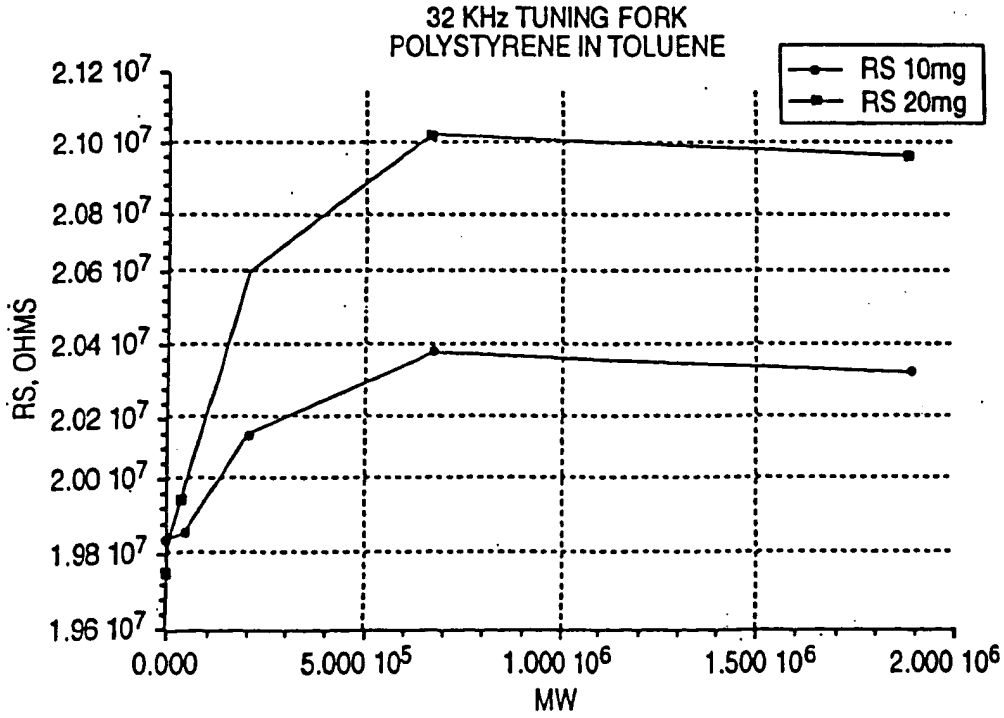

32 KHz TUNING FORK
POLYSTYRENE IN TOLUENE
RS 10mg
RS 20mg
RS, OHMS
2.12 10⁷
2.10 10⁷
2.08 10⁷
2.06 10⁷
2.04 10⁷
2.02 10⁷
2.00 10⁷
1.98 10⁷
1.96 10⁷
0.000
5.000 10⁵
1.000 10⁶
1.500 10⁶
2.000 10⁶
MW

FIG.8b

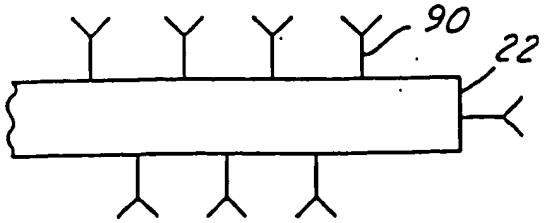


FIG.9a

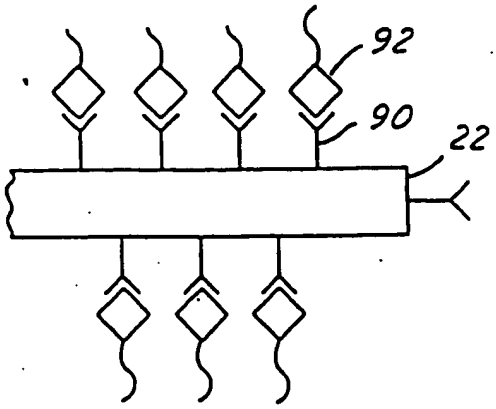


FIG.9b

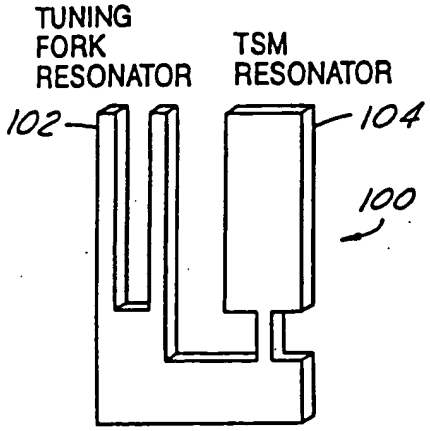


FIG.10a

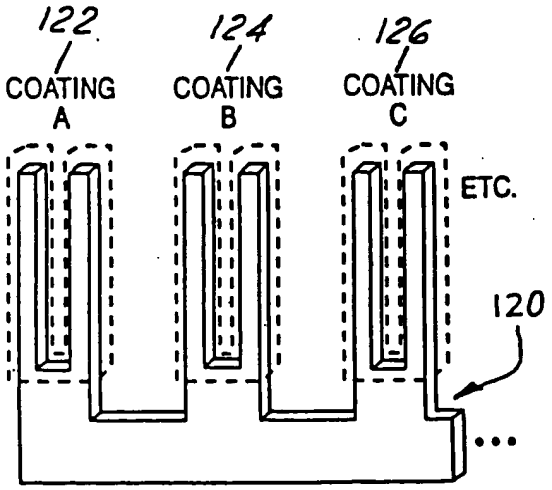


FIG.10c

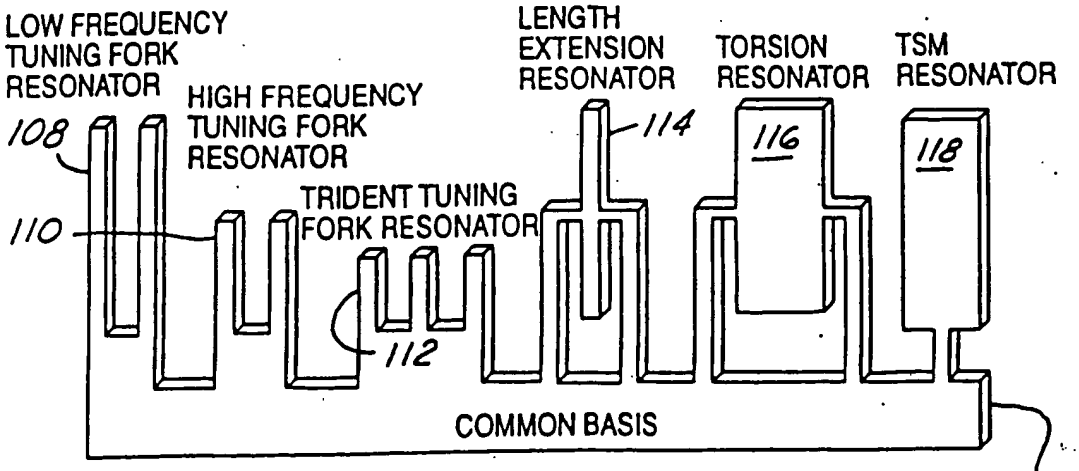


FIG.10b